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ABSTRACT

Sixty kindergarten, 60 second-grade, and 60 fourth-grade students performed several memory tasks under one of six conditions. The conditions differed as to the method of presentation of information. The study was focused on developmental changes in children's use of verbal, nonverbal, and spatial-positional cues for memory. The results, in general, showed consistent trends suggestive of a developmental change in representational ability; such that younger children tend to rely on visual cues and older children tend to rely on verbal cues to retain information. Children in all grades performed better when both visual and verbal cues were available and demonstrated an ability to utilize spatial-positional cues for retention. (Author)

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DEVELOPMENTAL CHANGES IN THE EFFECT OF VERBAL, NON-VERBAL
AND SPATIAL-POSITIONAL CUES ON RETENTION

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DEVELOPMENTAL CHANGES IN THE EFFECT OF VERBAL, NONVERBAL
AND SPATIAL-POSITIONAL CUES ON RETENTION

One of the most common types of internal representation for the human organism is the utilization of the verbal symbol. Many theories of cognitive development (e.g. Bruner, 1964; Piaget, 1952; Piaget & Inhelder, 1969) conclude that such use of verbal symbols is a rather advanced form of cognitive activity. It is generally conceded that a fully developed use of symbolic reference (the idea that there is a name that goes with things and that the name is arbitrary) is not available to the young child who begins to talk. Hence the child probably first learns words as signs rather than as symbols standing for some object present before him. Flavell, Beach and Chinsky (1966) found that the child who 'has' a language may still not know exactly when and where to use what he has. They found that, while he is able to demonstrate linguistic competence by using verbal sounds in certain contexts, the child may not have learned to do this in all contexts, for many tasks which required verbal coding and rehearsal were found to be too difficult for kindergarten children. Flavell, Beach, and Chinsky's results indicate that these same kindergarten children find difficulty in representing information by means of abstract symbols, such as words. Much of the young child's information becomes internally represented through the use of imagery, imagery in this instance referring to a non-verbal copy of a particular experience.

Developmentally, the child's memory improves with age (Baker & Leland, 1959; Terman & Merrill, 1937; Wechsler, 1949). Additionally, it can be inferred from Piaget's and Bruner's theories that changes also occur in the characteristic modes of representation on which memory depends. For example, in those tasks in which a child is given a verbal direction and is required to complete the task as specified by the direction, children whose dominant mode of representation is ikonic should find such tasks considerably more difficult than children whose dominant mode of representation is symbolic.

Thus, if the representational system of young children does not utilize or is only minimally able to deal with abstract symbols, the expected results requiring the utilization of these abstract symbols would yield low estimates of memory. Conversely, if the information to be remembered and the response requirements of the task were more amenable to the child's representational system, a higher performance would be expected. Corsini (1969a), using a memory task in which kindergarten children were given instructions dealing with manipulation of familiar objects, varied the mode of presentation of material. Instructions were presented to kindergarten children in four different ways: once verbally without visual cues and three conditions where verbal instructions were accompanied by visual cues. His findings were interpreted as being in general agreement with the predictions of Piaget and Bruner concerning the mode of representing information; when information was presented to the child in a form which allowed for imagistic representation, the child's retention was significantly improved. In a second study, Corsini (1969b) examined developmental changes in pre-school and second grade subjects in memory as a function of the mode of presentation of instructions. Pre-

school subjects performed better when both verbal and non-verbal cues were available than when only verbal cues were present, yet no significant increase was found in retention of information for second grade subjects when non-verbal cues accompanied verbal ones.

One of the principal causal factors in the increased capacity for retention during childhood is attributed to increasingly better organization of the material to be retained. Werner (1948) found the younger child tends to apprehend and reproduce the material in continuous, chain-like wholes, while older children do it in patterns in which parts are related to one another and the whole. The use of a sophisticated approach (serial ordering) in recall, in contrast to a relatively simple approach (clustering), appears to occur relatively late in development (Rossi & Rossi, 1969). In retention, therefore, the type of task is a significant factor. The learning of different memory tasks may be facilitated by different presentations, giving better opportunities for material organization. The present study used a variety of tasks to determine the extent to which kindergarten, second grade and fourth grade children use visual, verbal and a combination of visual and verbal cues for successful retention.

The present study permits also the examination of developmental changes in the use of spatial-positional cues. Emerson (1931) found that children age two and three are confused when asked to perform tasks in which the spatial arrangement was changed but no confusion occurred with five year olds. Corsini (1972) explored kindergarten children's use of memory codes that were dependent upon spatial positions of stimulus objects. He gave instructions in

different spatial locations; thus, he argued the child could not use the spatial-positional information without forming an internal code resistant to spatial and temporal displacement. Corsini failed to obtain any significant differences between his conditions dealing with spatial-positional cues. Yet in another study, Corsini (1970b) reported that somewhat older children use this type of spatial-positional coding strategy. In this latter study, second grade students performed significantly better when the spatial positions of objects were identical.

Method

Subjects

The sample consisted of 180 Ss; 60 kindergarten children (mean CA of 5 years 4 months), 60 second-grade children (mean CA of 7 years 3 months), and 60 fourth-grade children (mean CA of 9 years 4 months). The distribution of boys and girls in each grade was approximately equal. The Ss were obtained from three middle class schools in the Montréal area. Although no formal intelligence test data were available, the middle class socio-economic status suggests that these Ss were of average intellectual ability.

Materials

Materials used in Task A and Task B were identical, while those used in Task C and Task D were somewhat different.

Task A and Task B. The equipment consisted of toy cars, planes, buttons, cups and boxes. Each of the objects presented was either red, yellow, blue, or green. For demonstration of the tasks, the equipment was arranged directly in front of the subject. All objects were clearly

visible to the subject and an additional set of identical objects was placed on a table 90 degrees to the right of the subject. A screen was used to assure that the subject was unable to see the arrangement of the material on the table to his right until the specified time. The material on this table was used by the subject to perform the tasks.

Task C. The equipment consisted of two sets of identically colored 'popsicle' sticks. Each set consisted of seven sticks (red, blue, yellow, green, brown, orange, and purple). One set of sticks was arranged directly in front of the subject. The second set of sticks was arranged on the table to the right of the subject.

Task D. One set of five colored blocks (white, red, blue, yellow, green).

Tasks and Conditions

There were four tasks, most of which were given under six conditions. The tasks varied in the type of material used and the response involved (i.e., serial ordering vs. material manipulations). The conditions differed as to the manner of presentation of the task and the spatial arrangement of the objects. All tasks involved one of three types of instructions (visual, verbal, and a combination of visual and verbal).

Conditions

Condition I (Visual-Only-Identical). Under this condition the subject was told to watch carefully as the experimenter manipulated the objects so that he could perform the same manipulations. After the experimenter had performed the manipulations for an instruction and following an interval of approximately eight seconds, the subject turned to the second table (90 degrees to his right) and attempted to perform the manipulations using the

identical set of objects on his table. In this condition the spatial arrangement of objects during a subject's performance was identical to the spatial arrangement of objects when the instructions had been given.

Condition II (Verbal-Only-Identical). Under this condition the subjects were asked to listen carefully while the experimenter told them what to do. After an interval of approximately eight seconds, the subject turned to the second table (90 degrees to his right) and attempted to perform the manipulations using the identical set of objects on his table. In this condition the spatial arrangement of objects during a subject's performance was identical to the spatial arrangement of objects when the instruction had been given.

Condition III (Visual-Verbal-Identical). Under this condition the subject was told to watch and listen carefully as the experimenter simultaneously manipulated the objects and gave instructions verbally. After an interval of approximately eight seconds, the subject turned to the second table (90 degrees to his right) and attempted to perform the instruction using the identical set of objects on his table. In this condition the spatial arrangement of objects during a subject's performance was identical to the spatial arrangement of objects when the instructions had been given.

Condition IV (Visual-Only-Different). This condition was identical to Condition I except that the spatial arrangement of objects during a subject's performance was different from the spatial arrangement of objects when the instructions had been given.

Condition V (Verbal-Only-Different). This condition was identical to Condition II except that the spatial arrangement of objects during a subject's performance was different from the spatial arrangement of objects

when the instructions had been given.

Condition VI (Visual-Verbal-Different). This condition was identical to Condition III except that the spatial arrangement of objects during a subject's performance was different from the spatial arrangement of objects when the instructions had been given.

Instructions

Task A and Task B each required four instructions at the Kindergarten level, five at the grade two level and six at the grade six level, instructions being used in increasing order of difficulty. Task C and Task D were continued until the subject made three consecutive errors.

Tasks

Task A. This task was concerned with manipulation of familiar objects.

Instruction 1. Put the yellow car into the red cup.

2. Put the blue car and red button into the green box.
3. Put the yellow button into the red cup, and the blue plane into the yellow box.
4. Put the blue car and the red button into the yellow box, and the yellow car into the blue cup.
5. Put the yellow car and the red button into the red box, and the blue car and yellow button into the blue cup.
6. Put the red car and the blue button into the yellow box, and the blue car and yellow button into the green box, and the red button into the red cup.

Task B. This task was concerned with manipulation of familiar objects, but instructions were cognitively oriented so that the subject was required to interpret the instructions before performing the task.

Instruction 1. Put the yellow thing you drive into the biggest cup.

2. Put the blue thing that flies and the biggest thing you do up your coat with into the smallest cup.

3. Put the biggest thing you do up your coat with into the smallest cup, and the blue thing that flies into the biggest box.
4. Put the yellow thing you drive and the smallest thing you do up your coat with into the biggest cup, and the blue thing that flies into the yellow box.
5. Put the biggest cup and the red thing you do up your coat with into the yellow box, and the blue thing that flies and the red thing you drive into the biggest box.
6. Put the blue thing you drive and biggest thing you do up your coat with into the smallest cup, and put the yellow thing you drive and the blue thing you do up your coat with into the largest box.

Task C. This task required the subject to place colored sticks in a specific order identical to that of the experimenter.

Instruction 1. Red

2. Yellow-green
3. Red-yellow-blue
4. Green-red-blue-yellow
5. Orange-blue-yellow-red-green
6. Brown-yellow-green-red-orange-blue
7. Green-orange-purple-yellow-blue-brown-red

Task D. This task was adapted from the Knox Cube and required the subject to reproduce the correct sequence of tapping colored blocks. This task was introduced to determine the effects of verbal cues on a visually oriented task.

Instruction 1. Red-green

2. Red-yellow-blue
3. Red-yellow-blue-green
4. Red-yellow-blue-green-red

5. Red-green-blue-yellow
6. Red-blue-yellow-green
7. Red-blue-red-yellow-green
8. Red-blue-yellow-green-blue
9. Red-green-blue-red-yellow-green
10. Red-blue-yellow-green-red-blue
11. Red-green-blue-red-yellow-green
12. Red-blue-yellow-green-blue-red-green
13. Green-yellow-blue-red-yellow-blue green-blue

Procedure

The subjects (by grade) were assigned randomly to one of the six conditions. The order of tasks was randomized. Subjects were brought individually to the experimental room and were informed that they were helping the experimenter with a school project. For the purpose of determining whether or not the subjects could identify all the objects, all subjects were asked to name the objects and colors involved in the instructions. In addition, all subjects were asked to point to the following object; the object one would drive in (car), the object one would fly in (airplane), the object one uses to do up his coat with (button), the smallest cup, and the biggest box. Two kindergarten children were eliminated and replaced on the basis of being uncertain about objects and their colors.

Each child was shown the experimental materials, told that the experimenter was going to ask him to do different things, shown where to perform the tasks, and was given a practice trial (Level 1 instruction) for each task. The experimenter corrected any errors which occurred

during the practice trial and another practice trial was then given. The child was complimented on his performance after each trial. Only one experimenter was involved in the testing.

The nature of the experimental conditions precluded the performance of some of the tasks under each of the six conditions. Thus the subject in Condition I (Visual-Only-Identical) or Condition IV (Visual-Only-Different) could not perform Task B due to its cognitive nature. Task D was only performed in Conditions I, II, and III. Subjects assigned to Condition I received Tasks A, C, D; subjects assigned to Condition II received Tasks A, B, C, D; subjects assigned to Condition III received Tasks A, E, C, D; subjects assigned to Condition IV received Tasks A, C; subjects assigned to Condition V received Tasks A, B, C; and subjects assigned to Condition VI received Tasks A, B, C.

Scoring

Task A & Task B. Each of the objects and each of the receptacles that was used by the subject in his performance was given a score of 1 if it had been mentioned in the instruction. If the manipulated objects were placed in the proper receptacles and were completely correct, an additional point was given. This additional point was used to distinguish between a partially correct and completely correct performance. For example, in a Level 3 instruction a child could have correctly retained the four stimulus objects but had the placements reversed. If only the correctness of objects and not their placement was scored, this performance would not be distinguished from that which retained the correct object-receptacle relationships. Thus, the highest possible score for a Level 1 instruction would be 3, and for a Level 4 instruction the highest possible score would be 6.

Task C & Task D. Each correct response received a score of one.

Each instruction was scored as either correct or incorrect. The experimenter terminated the task after three consecutive failures. The maximum score for Task C and Task D was 7 and 13 respectively.

RESULTS

The relative efficiency of the various presentation methods was analyzed by making multiple comparisons of the performance scores for subjects in the Visual-Only Condition, the Verbal-Only Condition and those in the Visual-Verbal Condition. To determine the effects of spatial-positional cues for memory, the "Identical" Conditions (Visual-Only Identical, Verbal-Only Identical, and Visual-Verbal Identical) and the corresponding "Different" conditions (Visual-Only Different, Verbal-Only Different and Visual-Verbal Different) were compared.

A one way analysis of variance of the kindergarten data revealed a significant condition effect in Task A ($F=3.77$, $df=5/54$, $p < .01$), Task B ($F=11.26$, $df=3/36$, $p < .01$) and Task C ($F=3.77$, $df=5/54$, $p < .01$). The mean performance scores for the different conditions and tasks for kindergarten subjects appear in Table 1.

Insert Table 1 about here

The Neuman-Keuls analysis of the difference between performance means within the six conditions on Task A, Task B, and Task C are presented in Table 2. Performance for kindergarten subjects are greatest when both visual

Insert Table 2 about here

and verbal cues are present. Material presented visually does not appear to be retained more effectively than material presented verbally.

The one way analysis of variance of the second grade data revealed a significant condition effect in Task A ($F=3.00$, $df=5/54$, $p<.01$), Task B ($F=5.05$, $df=3/36$, $p<.01$) and Task C ($F=5.31$, $df=5/54$, $p<.01$). The mean scores appear by condition in Table 3.

Insert Table 3 about here

The Neuman-Keuls analysis was performed to determine performance differences between the various conditions for Task A, Task B and Task C. The results of these analyses are presented in Table 4. Performance scores

Insert Table 4 about here

for second grade children does not indicate overwhelming support that material presented verbally is retained better than information presented visually. This was only found to be statistically significant in Task C.

A one way analysis of variance of the fourth grade data revealed a significant condition effect in Task A ($F=2.64$, $df=5/54$, $p<.05$) and Task B ($F=9.82$, $df=3/36$, $p<.01$), Task C ($F=2.46$, $df=5/54$, $p<.05$) and Task D ($F=5.78$, $df=2/27$, $p<.01$). The mean performance scores for the different conditions and Tasks appear in Table 5.

Insert Table 5 about here

The Neuman-Keuls analyses of the difference between performance means for all Tasks are presented in Table 6. Performance in Task C and Task D were

significantly better when information was presented verbally as compared

Insert Table 6 about here

with information presented visually. Yet in Task A, the opposite results were obtained. Performance scores were generally superior when both visual and verbal cues were available for fourth grade children.

To determine the overall spatial-positional effect, a t test was performed for each Task and each grade. This was done by combining the performance scores for the "Identical" Conditions where the spatial position of objects on the subject's table was identical with the objects on the experimenter's table (Conditions I, II and III), and comparing those performance scores with the scores for the "Different" conditions where the spatial position of objects on the subject's table was different from the experimenter's table (Conditions IV, V and VI). The results of these analyses indicated that there are no significant overall differences between the Identical and Different Conditions for kindergarten children on Task A, Task B and Task C. In addition, no significant differences existed for second grade students and fourth grade students on Task A, Task B, and Task C. Task D was only performed in the Identical Conditions (I, II, III), therefore no t test was performed on this task.

DISCUSSION

Successful performance in the present study required the child to form an internal representation of the information presented. If this information was presented verbally and the representational system of the young child did not enable him to deal with abstract symbols (i.e. words),

it was expected that information presented in this manner would be minimally retained thus yielding a low performance score. However if the information to be remembered was presented in a manner more amenable to the young child's representational system (i.e. visually) it was expected that information presented in this manner would increase retention. The results indicate that while performance scores for kindergarten children were greater for information presented visually for two tasks (Task A and Task D), performance was greater when information was presented verbally for presumably more conceptually difficult material (Task C). While some evidence exists that kindergarten children best use visual cues for retention, the results are not conclusive.

Second grade and fourth grade children were expected to retain more information presented verbally rather than visually due to previous experience, their relative mastery of the language and their cognitive capabilities. Performance scores for both groups indicated mixed results. Children at these age levels demonstrated superior performance in the verbal-only condition for two tasks (Task C and Task D) while scoring higher for information presented visually for Task A.

The results indicated that the availability of verbal cues in combination with non verbal cues facilitated retention in all groups. While Corsini (1972) found that non verbal cues in combination with verbal cues significantly increased retention of kindergarten children, in an earlier paper he (1969a) found that this was not true for second grade children. Thus the present study gives further credence to Flavell's (1971) "additive developmental sequence system" for describing different types of developmental sequences. According to Flavell, symbolic representation does not replace enactive and ikonic representation but becomes an additional method by which children are capable of forming representations. Moreover while

a particular representational ability may be dominant over other modes at a particular period in time, the different representational modes available to the individual are used when precipitated by a particular set of events. Children whose predominant mode of representation appeared to be verbal increased their performance scores when visual cues were also available. Similarly, children whose dominant mode of representation was visual demonstrated an increased capacity for retention of information when verbal cues were available. It is quite likely that the availability of another cue (i.e. either visual or verbal) does not merely become an additional method by which children are capable of forming internal representations but most likely assumes an additional motivational and attention eliciting function. While the particular representational strategies for young children are qualitatively different from those of older children, it appears that on occasion the strategies may be equally effective.

Indications as to whether kindergarten, second grade and fourth grade children use spatial positions and movements as a functional part of their memory code was analyzed by a comparison between performance in the "Identical" conditions (Visual-Only-Identical, Verbal-Only-Identical, and Visual-Verbal-Identical) and the "Different" Conditions (Visual-Only-Different, Verbal-Only-Different and Visual-Verbal Different). If the memory code is an imagistic representation of an action performed, children would most probably encode information based upon specific positions and movements. This should lead to superior performance under conditions in which the spatial arrangement of specific objects was exactly the same as at the time of encoding; it would be less successful as the conditions differ from those present at the time of encoding. Thus, when objects on the subject's

table are in a different spatial-positional arrangement from the experimenter's table, a decrement in performance should appear, attributable to inadequacy of earlier coding to cope with the new situation in which the children form a new, slightly different encoding of spatial arrangements and movements. The results indicated no significant overall differences between performance for kindergarten children in the "Identical" Conditions and the "Different" Conditions although mean scores for the Identical Conditions were slightly higher. Interestingly, the performance scores for kindergarten children in the Verbal-Only-Different Condition, for all tasks, were greater than performance scores in the Verbal-Only-Identical Condition. Similarly, differences were found between the Identical and Different Conditions for second grade and fourth grade children. Thus, it appears that the coding procedures used by the kindergarten children are capable of being modified or supplemented by the imposed new coding and that their use of spatial-positional cues are sufficiently developed by age 5 to withstand such changes.

While the findings of previous research and theoretical positions on developmental changes in the use of cues for memory are generally supported, the utilization of a variety of tasks, in the present study demonstrates the importance of situational and subject variables in this field of research. Since different results were sometimes found for different tasks, it is necessary when determining the probability of success in a memory task to consider the interaction among the conceptual complexity of the information presented, the conceptual capabilities of the learner, the manner in which the information is presented as well as the motivation, attention, and the degree of cooperation of the child.

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TABLE I

Mean Performance Scores by Kindergarten Children

Condition	Task A	Task B	Task C	Task D
I Visual-Only-Identical	9.20		2.10	5.20
II Verbal-Only-Identical	6.50	5.80	2.90	3.80
III Visual-Verbal-Identical	10.20	10.70	3.00	5.30
IV Visual-Only-Different	7.80		1.60	
V Verbal-Only-Different	8.60	7.20	3.00	
VI Visual-Verbal-Different	9.20	9.30	3.00	
Total	8.58	8.25	2.60	4.77

TABLE 2

Multiple Comparisons - Kindergarten Children

Task A				Task B				Task C			
(df = 5/54)				(df = 3/36)				(df = 3/54)			
Comparisons	q		p	Comparisons	q		p	Comparisons	q		p
II < I	2.70		n.s.	II < III	4.90		.01	I < II	.80		n.s.
I < III	1.00		n.s.	V < VI	3.50		.01	I < III	.90		n.s.
II < III	3.70		.01	II < V	1.40		n.s.	II < III	.10		n.s.
IV < I	1.40		n.s.	VI < III	1.40		n.s.	I < IV	.50		n.s.
II < V	2.10		n.s.					II < V	.10		n.s.
VI < III	1.00		n.s.					VI < III	.00		n.s.

TABLE 3

Mean Performance Scores by Second Grade Children

Condition	Task A	Task B	Task C	Task D
I Visual-Only-Identical	14.80		2.80	6.30
II Verbal-Only-Identical	11.90	11.80	4.10	7.50
III Visual-Verbal-Identical	15.40	16.00	3.50	7.70
IV Visual-Only-Different	13.00		2.30	
V Verbal-Only-Different	12.00	11.40	4.40	
VI Visual-Verbal-Different	15.90	14.70	3.70	
Total	13.83	13.47	3.47	7.17

TABLE 4

Multiple Comparisons - Second Grade Children

Task A				Task B				Task C			
df = 5/54				df = 3/36				df = 5/54			
Comparisons	q		p	Comparisons	q		p	Comparisons	q		p
II < I	2.90		n.s	II < III	4.20		.05	I < II	1.30		.05
I < III	.60		n.s	V < VI	3.30		n.s	I < III	.70		n.s
II < III	3.50		n.s	V < II	.40		n.s	III < II	.60		n.s
IV < I	1.80		n.s	VI < III	1.30		n.s	IV < I	.50		n.s
II < V	.10		n.s					II < V	.30		n.s
III < VI	.50		n.s					III < VI	.20		n.s

TABLE 5
Mean Performance Scores by Fourth Grade Children

Condition	Task A	Task B	Task C	Task D
I Visual-Only-Identical	22.90		3.60	6.70
II Verbal-Only-Identical	19.20	17.40	5.00	8.60
III Visual-Verbal-Identical	23.70	23.00	4.70	9.30
IV Visual-Only-Different	21.00		4.00	
V Verbal-Only-Different	18.20	16.80	4.50	
VI Visual-Verbal-Different	22.20	23.10	4.30	
Total	21.20	20.08	4.35	8.20

TABLE 6

Multiple Comparisons - Fourth Grade Children

Task A			Task B			Task C			Task D		
<u>df = 5/54</u>			<u>df = 3/36</u>			<u>df = 5/54</u>			<u>df = 2/27</u>		
Comparisons	q	p	Comparisons	q	p	Comparisons	q	p	Comparisons	q	p
II < I	3.70	n.s	II < III	5.60	.01	I < II	1.40	.05	I < II	1.90	.0
I < III	.80	n.s	V < VI	6.30	.01	III < II	.30	n.s	I < III	2.60	.0
II < III	4.50	n.s	III < VI	.10	n.s	I < III	1.10	n.s	II < III	.70	n.
IV < I	1.90	n.s	V < II	.60	n.s	I < IV	.40	n.s			
V < II	1.00	n.s				V < II	.50	n.s			
VI < III	1.50	n.s				VI < III	.40	n.s			